

Experimental Study on Biomass Gasification Technology to Produce Medium Heat Value Gas

Xiaodong Zhang, Jinsong Zhou, Zhongyang Luo^{*a}, Jieli Zheng, Ming Xu, Mengxiang Fang,
Kefa Cen

^aClean Energy and Environment Engineering Key Lab of MOE ,
Zhejiang University, 20 YuGu Road, Hangzhou, China 310027;
Fax: 86-571-7951616; zyluo@mail.hz.zj.cn

The study of biomass gasification technology has caused much interest in recent years. On the base of comprehensive comparison of different kinds of biomass gasification technology in domestic and foreign countries, the advantage and disadvantage of each type of technology was analyzed, and also the present condition and prospect of the study of biomass pyrolysis gasification technology was summarized in this essay. And then the work performed in the Institute for Thermal Power Engineering (ITPE) in Zhejiang University is introduced in the development of biomass gasification technology and equipment.

At present, the study of pyrolysis technology using soft straw feedstock like rice straw is still scare in the international study of biomass energy utilization. It is mainly because that this kind of biomass feedstock is difficult to be treated. And the content of alkali metals in the stock is relatively high, which may cause agglomeration during the process of gasification and combustion and influence the system operation. Toward this condition, one new type of biomass gasification technology by pyrolysis utilizing soft straw to produce medium heat value gas, together with one set of equipment and system, is developed in ITPE.

The biomass feedstock utilized in this system is crop straw, mainly rice straw, which is the most popular in Chinese rural area and is of large storage. The main products of the process are gas, semi-coke, and also tar of little amount. The overall gasification system can be separated into several subsystems according to the function. That is, gasification furnace system, gas condensation and cleanse system, gas reforming system, gasifier heating-up system, circulating water-cooling system, biomass feedstock cut and transportation system, operation monition and control system and gas storage and distribution system.

The operation process of the gasification system includes several processes. The cool-state start process is to raise the temperature of the gasification furnace to use the combustion of some fuel to meet with the temperature need of biomass feedstock pyrolysis and also change the state of the furnace from cool to hot. When the temperature is high enough, the formal operation of the system can be started, in which the biomass feedstock is fed into the furnace to pyrolysis, producing raw gas. And the overall gasification will last about four hours. Then following the pause process between runs, that is, the pause after the pyrolysis process of one furnace of biomass feedstock is completed. Then we can start another gasification operation. However, the hot-state start process will be conducted, using fuel already in the furnace like semi-coke or fuel from outside to raise the temperature a bit to meet with the need of one new gasification process. The last process is the stop of the system.

On one set of equipment based on this technology, which is of the size that can meet with the gas need of eighty households, many tests have been performed to test the technology and also the system. Through long period of operation and monition, it is proved that this biomass gasification technology with its equipment to produce medium heat value has good performance. Like technology simplicity, easy manipulation, wide adaptability, operation stability, low investment, high fuel utilization rate, high quality of pyrolysis gas, and so on. And it is appropriate to be used in wide rural areas in China. This type of gasification technology of soft straw is in the leading state in domestic biomass gasification investigation and also superior in international study. Some key technological parameters are advanced than some present technology of this type, like the heat value of gas(1950~3000Kcal/m³), CO content in the gas(=20%), content of tar in the gas(=50mg/m³), fuel utilization rate (85%), and so on. On the other hand, it solves some difficult problems in present study of biomass energy utilization to change rice straw into medium heat value gas of high quality. And at the same time, this technology can meet with the need of local residents towards high quality energy resource and decrease the pollution to the environment.

What's more, comprehensive utilization measurement is taken in this technology, in which the semi-coke, as one vice-product, can be completely utilized, either in combustion or as chemical material, or as fertilizer to be sent back into fields. And tar, as another kind of vice-product, has some business value too. In summary, this technology of biomass gasification is fit for the present situation of energy utilization and biomass resources.